**Section II (Remarks)**

**A. Status of Claims**

Claims 14-34 are under active examination. No amendments of the claims have been made herein.

**B. Claim Rejections**

In the June 5, 2007 Office Action, claims 14-31 were rejected under 35 USC 102(b) as being anticipated by Andricacos et al. (U.S. 5,352,350) and claims 32-34 were rejected under 35 USC 103(a) as being unpatentable over Andricacos et al. in view of Chung et al. (U.S. 6,409,903).

Such rejections are traversed.

The present invention relates to a copper ECD system control apparatus including a computational module and a control assembly.

The computational module is constructed and arranged to:

- select at least one dependent variable (Selected Variable(s)) that correlate(s) to ECD efficacy;
- perform regression analysis or multivariate calibration modeling of the copper ECD utilizing a wafer-based independent variable to generate a dependent variable equation for each Selected Variable; and
- solve the dependent variable equation for each Selected Variable by regression analysis to yield a solution value for each Selected Variable.

The computational module is adapted for coupling in signal processing/monitoring/control relationship with the ECD when the ECD has the wafer being plated as a cathode element of an electrochemical cell including a copper plating anode. The computational module is arranged to process an electrode parameter of the wafer as the wafer-based independent variable in the regression analysis.

The control assembly is adapted to modulate the ECD in response to the solution value for each Selected Variable.

By utilizing the wafer being plated as an electrode component of an electrochemical cell providing the sampled variable for regression analysis, the system of the invention conducts real-time monitoring reflecting conditions at the wafer, to provide a regression analysis output indicative of solution composition in the plating bath. Such "on wafer" ECD regression analysis metrology embodies a substantial advance in the semiconductor manufacturing art.

**The Andricacos 102(b) Rejection**

In order for a reference to anticipate a claimed invention under 35 USC 102(b), each and every claim limitation must be present in the cited reference.

The statement of rejection for the 102(b) rejection of independent claim 14 (from which all remaining claims 15-34 under consideration directly or indirectly depend) is set forth in paragraph 5 at page 2 of the June 5, 2007 Office Action, as based on the assertion that Andricacos discloses "a computation module constructed and arranged to perform a regression analysis" which is followed by the statement that Andricacos "is configured with a computation module capable of performing a regression analysis." These two statements characterizing the Andricacos reference are inconsistent with one another, but, more importantly, both are wrong. Andricacos does not disclose a computation module that is either "constructed and arranged" or "capable" of performing a regression analysis, for the plain and simple reason that Andricacos fails to describe any regression analysis.

In fact, there is not even a single mention of regression analysis in Andricacos.

In this connection, the Office Action at page 2 in paragraph 5 states that Andricacos "specifically discloses utilizing a wafer-based independent variable, such as the time integral of the plating current (col. 6, lines 41-63)." The time integral of the plating current is described by Andricacos as reflecting the amount of processing that the bath has performed, but Andricacos fails to disclose a computational module that is constructed and arranged for:

"performing a regression analysis or multivariate calibration modeling of the copper electrochemical deposition utilizing a wafer-based independent variable to generate a dependent variable equation for each selected dependent variable correlative of efficacy of the copper electrochemical deposition; and

solving the dependent variable equation for each selected dependent variable correlative of efficacy of the copper electrochemical deposition, by regression analysis, to yield a solution value for each selected dependent variable,"

as required by the applicants' broad claim 14. As indicated above, Andricacos fails to make even a single mention of regression analysis.

In addition to the above, in paragraph 6 at page 3 of the June 5, 2007 Office Action, the examiner has stated that

> **"In regards to claim(s) 14 [sic] 'said computational module being adapted for coupling in signal processing, monitoring and control relationship with the electrochemical deposition system when said electrochemical deposition system is arranged with the wafer being plated constituting a cathode element of an electrochemical cell including said copper plating anode, and said computational module being arranged to process an electrode parameter of said wafer as said wafer-based independent variable in said regression analysis,' Andricacos teaches such a computational module adapted for coupling the claimed limitations."**

The significance of this statement is appropriately assessed in the context of the characterization of Andricacos in paragraph 15 bridging pages 4 and 5 of the June 5, 2007 Office Action, where it is stated that

> **"Andricacos et al. does not specifically disclose a wafer as an electrode component of an electrochemical cell."**

These statements are inconsistent. If as conceded by the examiner Andricacos does not disclose a wafer as an electrode component of an electrochemical cell, then Andricacos cannot disclose a computational module that is "adapted for coupling in signal processing, monitoring and control relationship with the electrochemical deposition system when said electrochemical deposition

system is arranged with the wafer being plated constituting a cathode element of an electrochemical cell." Andricacos therefore cannot logically be said to describe an adaptation for a specific structural arrangement, when the essential parts of that specific structural arrangement are not disclosed in Andricacos.

For all of the foregoing reasons, Andricacos fails to anticipate applicants' claim 14.

Since each of the remaining claims 15-31 rejected under 35 USC 102(b) on Andricacos depends directly or indirectly from claim 14, claims 15-31 are likewise distinguished over Andricacos.

**The Andricacos in view of Chung 103(a) Rejection**

Concerning the rejection of claims 32-34 under 35 USC 103(a) based on Andricacos in view of Chung, Chung has been cited as disclosing a wafer as an electrode component of an electrochemical cell, with the contention that it would have been obvious to modify Andricacos with the Chung wafer as an electrode component in order to plate copper on the wafer.

This stated basis, however, is no basis at all, since Andricacos already provides a system that can plate copper on a wafer, and there is NO need or reason to modify Andricacos to do what Andricacos already does – plate a workpiece.

Andricacos states at column 1, lines 7-9 that the disclosed invention of such reference "relates generally to the field of wet chemical baths used in processes for treating workpieces, for example, plating processes." Since Andricacos already provides the workpiece plating that is the stated reason for modifying Andricacos by Chung, there is in fact no logic or reason for any attempted synthesis of the two references. The hypothesized modification of Andricacos in view of Chung therefore provides no basis for the alleged obviousness of applicants' claims 32-34.

Even apart from this lack of any tenable basis for the hypothetical modification of Andricacos by Chung, it has already been established in the preceding discussion that Andricacos fails to disclose any regression analysis or computational module of the type required in claim 14. Since

claims 32-34 variously depend from claim 14, they too require a computational module constructed and arranged for:

"performing a regression analysis or multivariate calibration modeling of the copper electrochemical deposition utilizing a wafer-based independent variable to generate a dependent variable equation for each selected dependent variable correlative of efficacy of the copper electrochemical deposition; and

solving the dependent variable equation for each selected dependent variable correlative of efficacy of the copper electrochemical deposition, by regression analysis, to yield a solution value for each selected dependent variable,"

but this deficiency of Andricacos is not satisfied by Chung, since Chung merely presents a multi-step potentiostatic/galvanostatic plating process in which a sub-threshold voltage is applied to a cathode and anode during a first time period, and a current is applied to the cathode and anode during a second time period so that the current produces a voltage below the threshold voltage, or, alternatively, a current ramp-up process with the same sub-threshold voltage objective.

Chung's methodology is intended to avoid "burn-through" of a seed copper layer that otherwise occurs with the application of large DC-potentials to such copper layer. There is no description in Chung of any regression analysis or computational module as required by applicants' claims.

For such additional reason, the proposed synthesis of Andricacos and Chung affords no basis for the applicants' claimed invention.

Based on all of the above, applicants' claims 32-34 are patentably delineated over Andricacos in view of Chung.

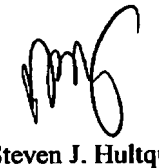
It correspondingly is requested that such rejection of claims 32-34 be withdrawn.

## CONCLUSION

Based on the preceding remarks, applicants' pending claims 14-34 are patentably distinguished over the art, and in form and condition for allowance. The examiner is requested to issue a Notice of Allowance.

If any matters require further resolution, the examiner is requested to contact the undersigned attorney at (919) 419-9350 to discuss same, in order that the application can be rapidly processed and allowed at an early date.

Respectfully submitted,



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